

### Notes: The Big Bang

- a. Read 30.1 The Big Bang once. **Highlight** information, Underline names and dates, circle new vocabulary.
- b. Read it a second time and follow the guidelines below to take Cornell Notes.

What happened following the Big Bang?	
What is the primeval fireball?	
Two main bodies of evidence for the Big Bang	Cosmic Background Microwave Radiation (CMBR) And Red-shifted light from distant galaxies
Cosmic Background Microwave Radiation (CMBR)	<ul style="list-style-type: none"><li>- Description</li> <li>- discovered by</li></ul>
Red-shifted light from distant galaxies	<ul style="list-style-type: none"><li>- Description</li> <li>- discovered by</li></ul>
Summary	

## 30.1 The Big Bang

Compelling evidence suggests that the universe began 10-15 billion years ago, when a primordial explosion called the **Big Bang** occurred. Theorists generally believe that within the first three minutes after the Big Bang, great quantities of hydrogen and helium were created, spewing apart at great speeds. About 3 million years later, huge clouds of this matter, stretching 500 million light-years across, began to condense. After about 200 million years, these condensations formed the first galaxies-the birthplace of the stars and of elements heavier than hydrogen and helium. The Universe today is the remnant of the Big Bang.

The concept of the Big Bang came into focus in the 1930s, after the American astronomer Edwin P. Hubble, for whom the Hubble Telescope is named, showed that the universe is expanding. Further findings implied that the cosmos was once concentrated in a very small, hot place at a definite time. The concept of the Big Bang holds that this special time was the *beginning of time*.

The space formed by the Big Bang was filled by intense, extremely energetic high-frequency radiation called the **primeval fireball**. Radiation from the dying embers of the primeval fireball now permeates all of the space in the form of microwaves, which continuously stretch out more and more as the universe expands. These microwaves were inadvertently discovered in 1964-65 by Arno A. Penzias and Robert W. Wilson of Bell Laboratories while they were trying to rid their radio antenna of microwave noise. The microwave background radiation they discovered was predicted by Big Bang theory. Then in 1992, measurements of miniscule variations in the background radiation vindicated another prediction of Big Bang theory-that only such variations could account for the accumulation of matter to form galaxies.

That the universe is still expanding today is evident in a Doppler red shift in the light we receive from its galaxies. Recall from section 10.10 that sound and light waves perceived by an observer are stretched out when a source recedes and compressed when a source approaches. The visible light we see from distant galaxies is stretched out, which means it is red-shifted and therefore indicates a receding light source. In other words, the red shift shows an increasing distance between us and other galaxies in the universe. This does not, however, place our Milky Way Galaxy in a central position. To see why not, consider a balloon with ants on it: As the balloon is inflated, every ant sees every other ant getting farther away, which certainly doesn't suggest a central position for each ant. In an expanding universe, any observer sees all other galaxies receding.

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